

AD-A031 225

AIR FORCE PACKAGING EVALUATION AGENCY WRIGHT-PATTERSON--ETC F/G 19/2  
CNU-179 A/E CONTAINER ROUGH HANDLING AND VIBRATION TEST.(U)  
OCT 76 R T GIBBONS

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Technical ref.

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ROUGH HANDLING AND VIBRATION TEST.

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Wright-Patterson AFB OH 45433

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## ABSTRACT

ADTC/Eglin AFB FL requested that the Air Force Packaging Evaluation Agency conduct rough handling, vibration, and mechanical handling tests on the proposed CNU-179 A/E container. At the time of testing, an evaluation of the three proposed types of stacking lugs was made. The container design was developed because of an internal corrosion problem existing on the CNU-180 E containers. Both type containers hold two CBU 58B (SUU-30H/B) bomblet dispensers. The corrosion problem in the CNU-180 E container developed when cracks and punctures appeared, causing water to be trapped inside. This trapped water would then cause a situation leading to an unacceptable number of dispenser failures.

The CNU-179 A/E containers furnished by ADTC provided adequate protection to the CBU-58B dispensers during testing and should provide the required protection when exposed to the transportation and storage environment throughout the distribution system.

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## INTRODUCTION

The Air Force Packaging Evaluation Agency received six CNU-179 A/E containers for testing and evaluation. The test plan used is outlined in Figure 1, page 11. Representatives from ADTC, Eglin AFB FL and AFLC/DSP, Hill AFB UT were present for the majority of the testing.

The six containers submitted for test and evaluation were identical except that the covers were fabricated with three different types of stacking lugs. These lugs can be seen and identified in Figure 2, page 2. The main difference between the existing CNU-180 E container and the proposed CNU-179 A/E container is that the former provides Method II protection, while the latter is Method III. MIL-P-116, Section 1.2, defines Method II as "water-vaporproof barrier with desiccant (with contact preservative when required)"; and defines Method III as "packaged for mechanical and physical protection only". The method change was made because of damage to the CBU-58B dispensers which occurred not because of water vapor but rather from standing water inside sealed containers that were damaged and leaked. The CNU-179 A/E container was designed with drain holes to eliminate this problem.

The containers were submitted by ADTC, Eglin AFB and manufactured by Lanson Industries, Cullman AL. Both the built-up and collapsed container can be seen in Figure 3, page 13. The side and end panels are shown in Figure 4, page 13, just prior to replacing the top cover. Figure 5, page 14, shows the bottom polystyrene blocking and bracing while Figure 6, page 14, shows the top with the two wooden lug restraints in place. Prior to fabrication of these containers, representatives from ADTC, Eglin AFB, AFLC/DSP and MM, Hill AFB UT and AFALD/PTPD, Wright-Patterson AFB OH met with the engineers at Lanson Industries to discuss preliminary designs and to evaluate problems with the current CNU-180 E container.

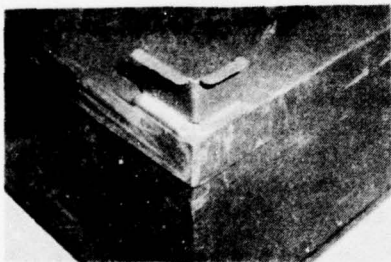
## INSTRUMENTATION

An Endevco, Model 2233E, piezoelectric accelerometer was used to instrument the drop tests, pendulum impact, and vibration tests. The accelerometer was used to measure the shock input to the CBU-58B dispenser along the vertical main axis; and was mounted on the center of gravity of one dispenser in between the hoisting lugs.

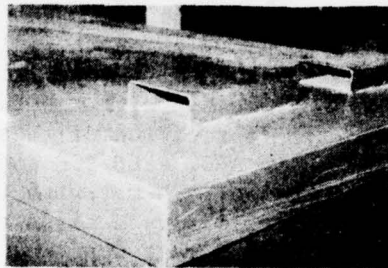
Conditioning of the accelerometer output was accomplished by an Endevco, Model 2641C, charge amplifier powered by an Endevco, Model 2622C power supply. The continuous output was displayed on a Tektronix, Model 564B, storage oscilloscope, equipped with a Tektronix still camera, Model C-12. The output was also displayed on a Bell & Howell Datagraph 5-134 chart recorder.

#### TEST OUTLINE

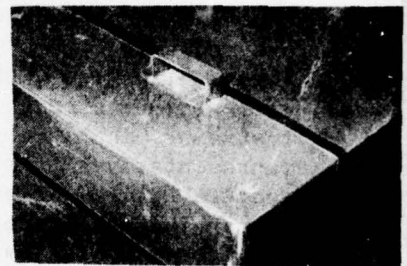
The tests conducted on the CNU-179 A/E container (shown in the test plan, Figure 1, page 11) were completed during 18-27 Aug 1976. An example of the type of container tested is shown in Figure 3, page 13. Three types of stacking lugs were used to identify the containers as shown in the index below.



TYPE I



TYPE II



TYPE III

Figure 2. Stacking Lug Options

Following are tests performed, on the containers indicated, in accordance with Federal Test Method Standard 101B using the methods indicated. The actual sequence is as follows:

<u>TEST #</u>	<u>TEST</u>	<u>FTMS METHOD</u>	<u>CONTAINER</u>	<u>ORIENTATION</u>
A1-1	Vibration	5019	I-1	
B1-1	Cornerwise Drop	5005	I-2	Forward end
B2-1	Edgewise Drop	5008	I-2	Forward end
B1-2	Cornerwise Drop	5005	I-2	Diag. opposite B1-1
B2-2	Edgewise Drop	5008	I-2	Aft end
B3-1	Pendulum Impact	5012	I-2	Forward end
B3-2	Pendulum Impact	5012	I-2	Aft end
B3-3	Pendulum Impact	5012	I-2	Right side
B3-4	Pendulum Impact	5012	I-2	Left side
A1-2	Vibration	5019	I-2	
B3-5	Pendulum Impact	5012	II-1/III-1	Forward end
B3-6	Pendulum Impact	5012	II-1/III-1	Aft end
B3-7	Pendulum Impact	5012	III-1/II-1	Forward end
B3-8	Pendulum Impact	5012	III-1/II-1	Aft end
C1	Mech Handling	5011	III-1	
D1	Stacking	5017	A11	
A1-3	Vibration	5019	II-2/III-1	
E1	Drainage	N/A	III-1	

## TEST PROCEDURE AND RESULTS

1. Vibration (Test # A1-1). The equipment used to conduct vibration testing was a L.A.B. Vibration Machine, serial 56801, type 5000-96B. The basic vibration platform was fitted with a table adapter constructed of plywood measuring 96" long by 96" wide by 1.5" thick bolted to the original vibration table. The container was vibrated on this platform at 4.5 Hz for 1.5 hrs. The 4.5 Hz was selected as the vibration frequency because at this point, the container was receiving a 1G shock from the 1" double amplitude displacement. Shock readings from the recording systems indicated that the dispenser was receiving from 12-16G's per impact.

Damage to the container consisted of one broken banding strap and deformation in the bottom of the exterior container. The vibration test had to be terminated after 1.5 hours elapsed time due to an unbalancing of the container which caused a "walking" condition.

The two CBU-58B dispensers were not damaged when visibly inspected at the conclusion of this test. One dispenser had, however, rotated approximately 10° so that the stacking lugs were out of the wooden restraint. This is shown in Figure 7, page 15.

2. Cornerwise Drop (Test # B1). One corner of the base was supported on a block nominally 6" high and a block nominally 12" high was placed under the other corner of the same end. These blocks provided a condition where there was no support for the base between the ends of the container during the drop. The unsupported end of the base was raised so that the lower corner of the base was raised 24". The container was then released and allowed to impact the concrete floor. This test was applied to two diagonally opposite corners of the base of the container.

The first cornerwise drop (B1-1) produced a buckling in the bottom of the container at a point approximately 1/3 from the forward edge at the point where the side fits into the bottom flange. Splits also began to appear in the skid. The second cornerwise drop (B1-2) produced additional buckling in the container bottom and also increasingly split a longitudinal outside wooden skid. Due to the buckling, the foam blocking was slightly visible. The container remained in a usable condition and the testing was continued. Oscilloscope readings were unusable due to "high ringing" in the container which distorted the trace.

3. Edgewise Drop (Test # B2). The container was placed on its bottom with one end of the base of the container supported on a sill nominally 6" high. This height assured that there was no support of the base between the end of the container during dropping. The unsupported end of the container was then raised to a height of 24" and released for impact. This test was applied to each end of the container.

The initial edgewise drop (B2-1) separated a bottom corner weld, continued the buckling started in the cornerwise drop and started a crack in two places on the longitudinal skid and one on an end traverse skid. The center vertical strap broke causing the center to bend. The second edgewise drop (B2-2) did not seem to appreciably increase damage to the container, other than continuing damage already present. The container was still usable after these tests. The CBU-58B dispensers were inspected at this time and were found to be in good condition. The polystyrene blocking and bracing had minor dents and cracks but was still serviceable (as shown in Figure 8, page 15). Again, no reading was obtainable from the oscilloscope recording system. Four vertical straps were used to reseal the container.

4. Pendulum Impact (Test # B3). The container was placed on the platform with the impact end extending over the edge of the platform just enough to make contact with the concrete bumper. The platform was then pulled back so that the center of gravity of the container was raised 9". Upon release, the platform then swung to impact the concrete bumper with an impact velocity of 7 fps. This procedure was followed for testing both ends and both sides of the container.

The first and second impacts (B3-1, B3-2) resulted in little more than minor dents to the end impacted. There also was additional deformation of the edges at the bottom and increases in the cracks and splits of the wooden skid. The next two impacts (B3-3, B3-4) did no additional exterior damage. The container was then opened and inspected. The polystyrene blocking and bracing had several breaks in the ends (shown by Figure 9 and 10, page 16) but was still functioning therefore the testing continued. The recording devices provided no readable trace on these tests.

5. Vibration (Test # A1-2). The procedure for this test was identical to that in test 1. At this time, the test was conducted for the full two hours specified. Four 3/4" straps were used as the vertical restraints.

This test resulted in additional internal and external damage to the container. The damage is shown in Figures 10-13, pages 16 thru 18. The bottom of the external container was further distorted and three cracks developed at various stress points on the container. The interior blocking and bracing was chipped in many places with cracks developing at the ends. One end was broken out but was still providing protection. There was no damage inside or outside that disqualified this container, however, as in the first vibration test, one dispenser rotated. The degree of rotation was approximately 25°.

6. Pendulum Impact (Test # B3). The procedure for this test was identical to that used for the test in 4 above, except that only the ends were tested. On this series of tests, two containers, one atop the other, as shown in Figure 14, page 18, were impacted to provide insight as to the quality of the three various stacking lugs. Each type of container (I, II, and III as defined on page 2 ) was evaluated.

The first set of impacts was made on container III-1 with II-1 container stacked on top. There was no appreciable damage connected with this impact as shown in Figure 15, page 19. There was a slight rotation of the top container around the forward lug.

The second set of impacts was made on container II-1 with III-1 container stacked on top. The corners of the lid on the bottom container (II-1) split and allowed the lid to slide forward. The rotation of the top container around the forward lug was greater than in the impact above but not great enough for the top container to slide off. All four lugs on the bottom container were bent in the direction of impact.

The third set of impacts was made on container I-1 with III-1 container stacked on top. No damage was recorded. No rotation was observed.

All containers remained in a usable condition and would still provide the physical protection required. These containers were used in further testing.

7. Mechanical Handling (Test # C1). A hard rubber tired forklift truck was used on the AFPEA road test course for this phase of testing. The road course was set up to fully comply with FTMS Method 5011, para 6.2 and the procedure contained therein was strictly adhered to. The CNU-179 A/E container was lifted clear of the ground and tested on the road course to determine container stability.

The container handled very well on the road course and proved to be quite a stable load. It appeared that this container would be able to be safely transported under all but very unusual conditions.

The procedure for conducting the pushing test was to position the container on level clean dry pavement and to abut it with a forklift truck at one end and push the container at a rate of 35' in 85 seconds. After this was complete, the container was rotated 90 degrees and with the forklift truck abutted to the container side, again pushed 35' in 85 seconds.

The underside of the container was inspected for damage or excessive wear and none was found. The container also seemed quite stable while being pushed.

The towing procedure consisted of attaching slings to the end skids and towing the container by forklift truck over 100' of level dry pavement. The slings were then attached to the center skid so the container could be towed again over 100' of pavement.

Again, the underside of the container was inspected for damage and excessive wear and none was found. At the conclusion of testing for mechanical handling (C1) the container remained usable and further testing was conducted.

8. Superimposed Load (Test # D1). The container, loaded with two CBU-58B dispensers, was placed on a flat, level, rigid surface. Two additional loaded containers were placed atop the first approximating symmetrical uniform loading.

The prescribed superimposed load used is defined in Method 5017, Section 6.1, as  $W=50 \cdot A \cdot S$

$W$  = Weight of superimposed load in pounds

$A$  = Top area in square feet

$S$  = 2.0 for level A packaging

Therefore,  $W = 50 (23.66)(2.0) = 2366$  lbs or 1.17 additional containers. Actual weight used was 4020 lbs or 2.0 additional containers. The load was left in place for 60 hours.

Upon visual inspection, no displacement or distortion was noted.

9. Stacked Vibration (Test # A1-3). The procedure for this test is identical to the procedure used in the previously described vibration test (#1). For the purpose of this test, the containers were stacked in a two high configuration with two cargo type straps used to restrain any excessive movement. This arrangement allowed for movement of the top container not to exceed two inches.

The test ran for the full two hours as specified and at the conclusion of testing a visual inspection was made. No deficiencies, other than minor top denting, were observed.

10. Drainage (Test # E1). The container was set in a slightly forward end down configuration so as to use only the forward drain holes. This was done to represent a more extreme condition than would be encountered in an optimum level stacking. The top was removed from the container and water was poured in at the rate of 8.5 gal/min for 10 minutes. Total time for the container to drain was 11.25 minutes for a container drain rate of 7.5 gal/min.

The drainage rate exhibited by this container is adequate to prevent any appreciable water buildup.

11. Composite Test. At the request of the representative from OO-ALC/DSP, one container was run through the entire vibration and rough handling test (A1, B1, B2 and B3) without opening the container for inspection at the conclusion of each step. This was done mainly to evaluate the strapping system.

Exterior damage from this test did not differ significantly from the damage received from any previous tests. Upon the final inspection, at the end of test B3, there was no unusual damage to the interior blocking and bracing. An example is shown in Figure 16, page 19. All straps held up with no signs of fatigue.

## DISCUSSION

The areas of interest from the test results are indexed by test number. These areas for discussion are as follows:

1. Test A1-1. The wrong size and number of vertical straps was used causing the strap failure and subsequent container bottom failure. Three straps instead of the required four were used and the banding material was 3/8" wide instead of the 3/4" specified. This was done to determine if a thinner strap could withstand the

test for possible material conservation. Following these test results, all testing past B2-2 was conducted using four vertical 3/4" wide straps. The unbalancing of the container came when the dispenser had rotated past the wooden lug restraint.

2. Test B1 and B2. This test was also conducted with less than the optimum number of vertical straps. Perhaps some of the container buckling could have been avoided but there was not enough damage to condemn the container. The splits in the wooden skid were small enough to be disregarded.

3. Test A1-2. The cracks that developed at the stress points could be an indication that the bottom panel should be strengthened either by the addition of stiffeners or increasing the gauge of the panel.

4. Test B3-5 and 6. This test indicated the structural integrity of all lug designs. Also, the increase in impact force did not appreciably damage the container. (Since these containers will probably be shipped in a stacked configuration, this test was a good indication of what could be expected as far as load stability.)

5. The final rough handling test (11) was a combination of vibration, edgewise and cornerwise drop, and pendulum impact test without stopping for inspection of the container interior. This deviates somewhat from FTMS 101B but was done to evaluate, among other things, the strapping specified. It was shown in the initial vibration and drop tests that four straps 3/4" wide each, was necessary to contain this load.

6. The container, in total, was judged to be marginal but will provide protection to the items it contains. It was found not to be overdesigned, and yet considering the nature of the item it protects, is more than adequate.

#### RECOMMENDATIONS

The following list of recommendations is made as a result of inputs received from the test and evaluation performed at the AFPEA.

1. Lug restraint should be redesigned to eliminate rotation of dispensers. This could be done with a simple locking pin through a lug on each dispenser.

2. Four 3/4" vertical straps should be mandatory. A combination of wrong straps and dispenser rotation caused the uneven loading experienced in the vibration test A1.

3. The design of the stacking lugs is part of this evaluation. From all indications in the two-high pendulum impact test, the lug style I, Figure 2, page 2, appears the optimum to use. The other two styles proved difficult to stack from the standpoint of forklift operations.

4. The CNU-179 A/E container will provide adequate protection to the SUU-30 bombs when the above recommendations are followed. These should be no problem from standing water accumulating in the bottom of this container. This should eliminate the current situation experienced with the present SUU-30 container.

AIR FORCE PACKAGING EVALUATION AGENCY (Container Test Plan)					AFPEA PROJECT NUMBER 76-P7-40	
CONTAINER SIZE 89 x 39 x 27	GROSS WT 1200	(ITEM) 1000	CUBE 27.75 cu ft	QUANTITY 6	DATE 2 Jul 76	
ITEM NAME CEU-58 Bomb				MANUFACTURER Lanson Industries, Cullman, Al		
CONTAINER NAME CNU-179 A/E				CONTAINER COST		
PACK DESCRIPTION Method III Metal Container of Painted COR-TEN Steel						
CONDITIONING						
TEST NO.	IAW	PARAMETERS		ORIENTATION		INSTRUMENTED
A-1	Meth 5020 FTMS 101B	1" Double AMP 4.5 Hz				Yes
B-1	Meth 5005 FTMS 101B	24" Drop Height		Diag. opposite corners		Yes
B-2	Meth 5008 FTMS 101B	24" Drop Height		Opposite ends		Yes
C-1	Meth 5011 6.2, 6.5, 6.6 FTMS 101B	A/R		A/R		No
B-3	Meth 5012 FTMS 101B	7 FPS Impact		Each end and side		Yes
D-1	Meth 5017 FTMS 101B	3 high				No
COMMENTS						
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Figure 1

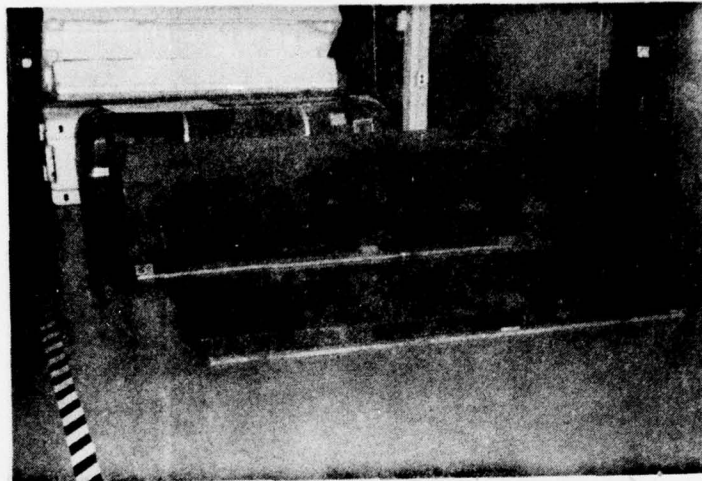


Figure 3. Assembled and Knocked-Down Container

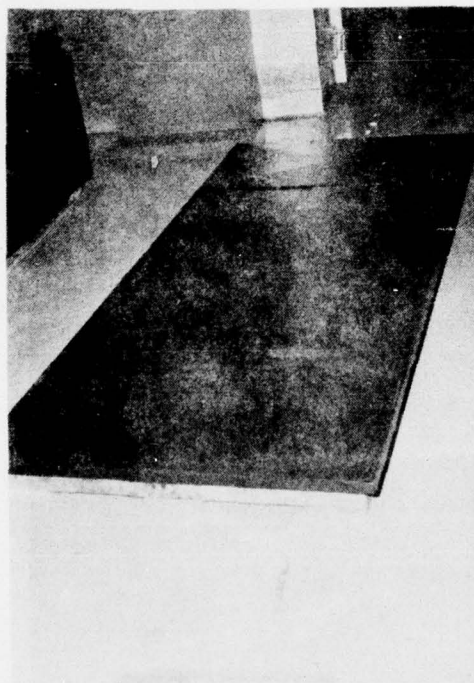


Figure 4. Side Panels in Knocked-Down Container

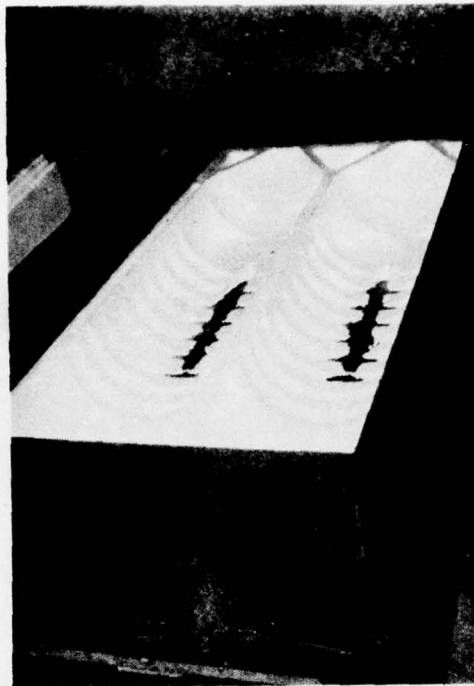


Figure 5. Interior Polystyrene Blocking and Bracing

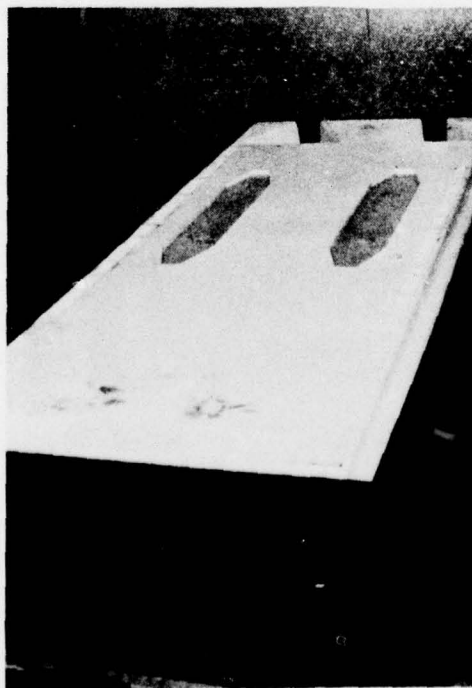


Figure 6. Top Dunnage With Wooden Lug Retainer



Figure 7. Bomb Rotation

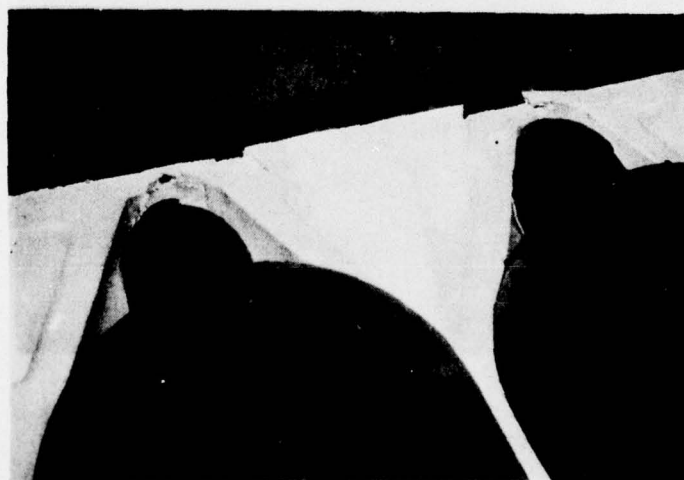


Figure 8. Forward End Damage



Figure 9. Aft End Damage

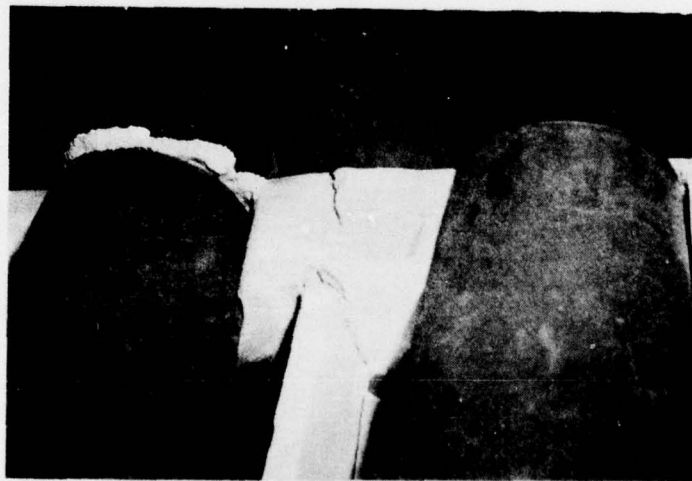


Figure 10. Divider Damage

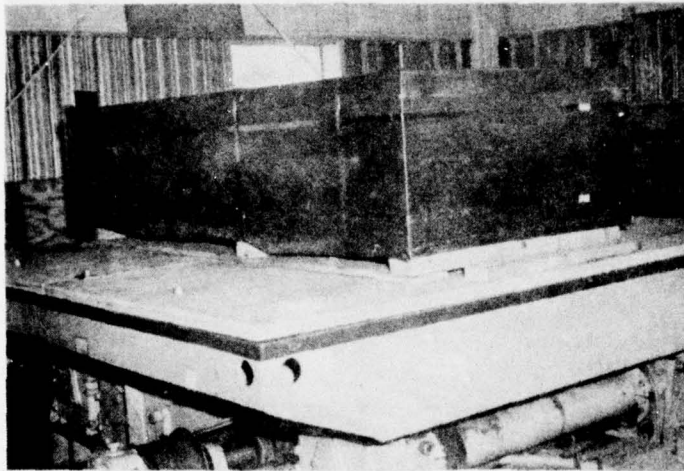


Figure 11. Container on L.A.B. Vibration Table

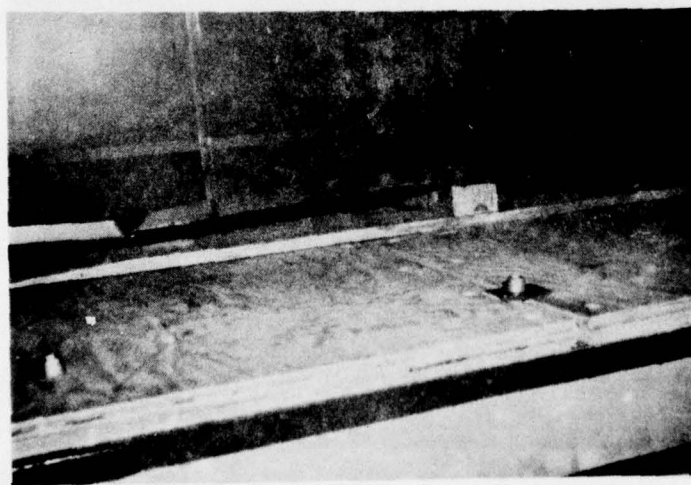


Figure 12. Container Side Damage

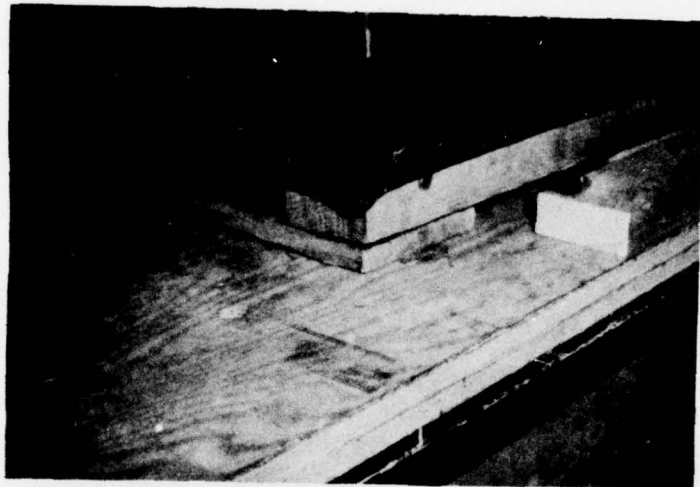


Figure 13. Container End Damage

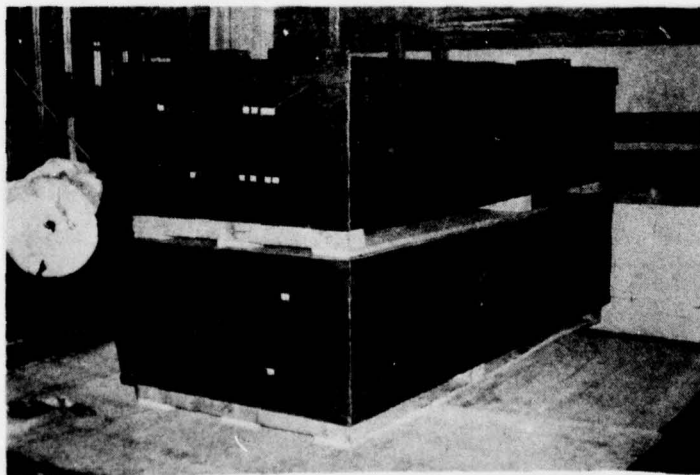


Figure 14. Two-High Pendulum Impact Test

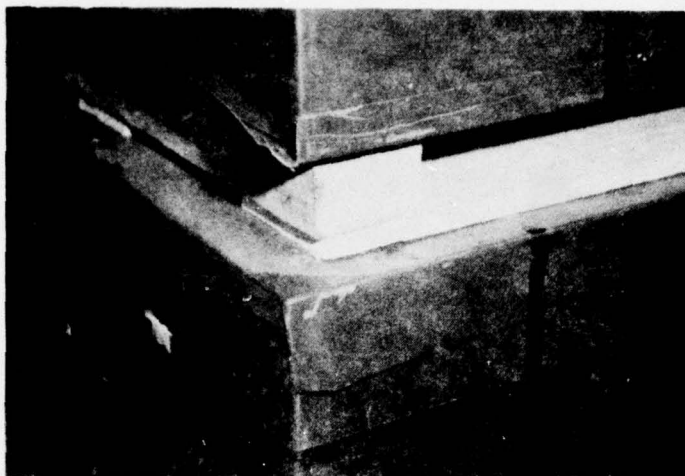


Figure 15. Pendulum Corner Damage

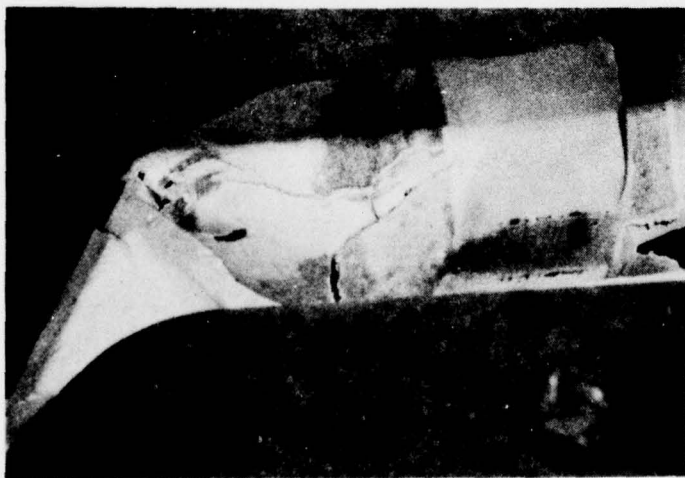


Figure 16. Additional Polystyrene Damage

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) ADTC/Eglin AFB FL has requested that the Air Force Packaging Evaluation Agency conduct rough handling, vibration, and mechanical handling tests on the proposed CNU-179 A/E container. At the time of testing, an evaluation of the three proposed types of stacking lugs was made. The container design was developed because of an internal corrosion problem existing on the CNU-180 E containers. Both type containers hold two CBU 58B (SUU-30H/B) bomblet dispensers. The corrosion problem in the CNU-180 E container developed when cracks and punctures appeared, causing water to be trapped inside. This		

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trapped water would then cause a situation leading to an unacceptable number of dispenser failures.

The CNU-179 A/E containers furnished by ADTC provided adequate protection to the CBU 58B dispensers during testing and should provide the required protection when exposed to the transportation and storage environment throughout the distribution system.

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